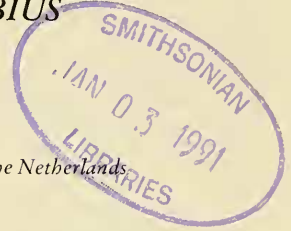


REVIEW OF THE SYSTEMATICS OF THE FAMILY CAMEROBIIDAE (ACARI, RAPHIGNATHOIDEA). I. THE GENERA CAMEROBIA, DECAPHYLLOBIUS, TILLANDSOBIUS, AND TYCHEROBIUS

by

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ABSTRACT

A review and a new classification of the family Camerobiidae are given. The family is now divided into five genera. A general key to the genera and a key to the species of the genera *Camerobia*, *Decaphyllobius*, *Tillandsobius* and *Tycherobius* are given. The species of the genus *Neophyllobius* will be described in the near future. The genus *Camerobia* now contains four species: the two new species, *C. pistaciae* and *C. monspeliensis*, and the earlier described species *C. australis* and *C. southcottii*. The latter one is the only known species in the family with dorso-sublateral setae. Three new genera are described: *Decaphyllobius* (type-species: *D. gersoni* spec. nov.), *Tillandsobius* (type-species: *Neophyllobius floridensis* McGregor) and *Tycherobius* (type-species: *Neophyllobius lombardinii* Summers & Schlinger). *Neophyllobius superbus* and *N. virginiensis* are transferred to *Tycherobius* gen. nov. which also contains the new species *T. polonicus* and *T. stramenticola*. *Neophyllobius citri*, *N. agrifoliae* and *N. hadros* are tentatively assigned to the genus *Decaphyllobius* gen. nov. and *Neophyllobius rhyttis* to the genus *Tycherobius* gen. nov. but this requires confirmation by study of the type-series.

INTRODUCTION

The stilt-legged mites (family Camerobiidae Southcott) form a group of Acari with a distinct and characteristic habitus. They have a dorso-ventrally flattened body provided with eight slender long legs on which they move rather cautiously.

Stilt-legged mites are usually found singly, or in very small numbers. For this reason many descriptions are based on single specimens. Aggregation of adult mites has never been reported; only juveniles seem to remain close to each other. It is therefore conceivable that even on favoured plants stilt-legged mites occur in low numbers. They are also found in grass, straw and tree litter of leaf mold samples, while their presence in soil samples is rather exceptional.

Very little is known about the biology of these mites. Only recently, the complete developmental cycle of a *Neophyllobius* sp. was described. It consists of egg, larva, protonymph and deutonymph. The deutonymph is very similar to the adult and has not been recognized as that before (Bolland, 1983).

Presumably all camerobiid mites are predators, preying on plant-associated mites, such as

gall, false spider and tydeid mites (Bolland, 1983; De Leon, 1958). They are also reported as predators of crawlers of scale insects (Meyer, 1962; Richards, 1962; Gerson, 1971, 1973; Gerson et al., in prep.; Hassan, 1976; Zaher & Gomma, 1979). Camerobiid mites are probably of little importance in regulating numbers of phytophagous mites or scale insects in plant ecosystems.

There are no reports on the dispersal of stilt-legged mites and information on their reproductive rates are likewise absent. Bisexuality has been demonstrated for a number of species. Karyotype studies have shown that sex-determination is based on haplo-diploidy: chromosome numbers of $2n = 22$ and $n = 11$ have been found in the eggs of *Neophyllobius aesculi* Bolland (Bolland, 1983). Haplo-diploidy is common in the order of Prostigmata (Helle et al., 1984).

It should be noted that a number of $n = 11$ is relatively high, since in other prostigmatic taxa the haploid numbers are usually lower, with $n = 2$ and $n = 3$ as being the most common.

Camerobiidae are capable of spinning: females of *N. aesculi* produce fine webbings to

cover their eggs (Bolland, 1983). The location of the spinneret is not known, but silken threads may very well be secreted through the eupathidia on the palptarsi. Several members of other prostigmatid families also produce silk, including the Bdellidae, Cunaxidae, Cheyletidae and Tetranychidae (Alberti & Ehrnsberger, 1977; Gerson, 1985).

Until now, only two genera were recognized in the Camerobiidae: *Camerobia* with two species (Southcott, 1957; Gerson, 1972) and *Neophyllobius* with 44 species.

The distribution of the Camerobiidae is worldwide. They have been reported from Europe, Asia, Africa, North and South America, Australia and New-Zealand, and from temperate as well as tropical zones. During the last few years the author studied many camerobiid specimens, belonging to 98 species, of which 50 appeared to be new. After this comprehensive study it was felt that the erection of more genera than *Camerobia* and *Neophyllobius* is justified. Therefore three new genera, namely *Decaphyllobius*, *Tillandsobius* and *Tycherobius* are proposed and separated by a key from the two genera recognized so far.

This paper further comprises a general review of the external morphology of the different developmental stages, the history of the family and the description of three new species, one in the genus *Decaphyllobius* gen. nov. and two in the genus *Tycherobius* gen. nov. The genus *Neophyllobius* will be dealt with elsewhere.

The chaetotaxy of the different genera of the Raphignathoidea (Atyeo, 1963), is difficult to compare with that of the Camerobiidae.

The terminology employed here is similar to that used by Gerson (1968). All measurements are given in μm and refer to the holotype, those in parentheses pertain to the paratypes. Scanning electronic microscopic (SEM) micrographs are given of a protonymph of *Decaphyllobius gersoni* spec. nov. (figs. 31—36).

ACKNOWLEDGEMENTS AND DEPOSITORIES OF MATERIAL STUDIED

The material studied in this paper belongs to the collections of the institutions mentioned below. I am indebted to the keepers of these collections for the loan of specimens. The abbreviations of the institutions are used throughout the text.

- BM(NH) British Museum (Natural History), Cromwell Road, London; Mr D. Macfarlane
- CAU College of Agricultural University, Szarvas, Hungary; Dr P. Szabo
- CS Collection Southcott, Mitcham, South-Australia; Dr R. V. Southcott
- DEUAL Department of Entomology, University of Agriculture, Lyallpur, Pakistan; Dr W. M. Chaudhri
- DCDG Doyle Conner, Commissioner of Agriculture, Division of Plant Industry, Gainesville, Florida; Dr H. A. Denmark
- FAUC Faculty of Agriculture, University of Cairo, Giza, Egypt; Dr M. A. Zaher
- HUJ Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot, Israel; Dr U. Gerson
- ISZA Istituto Sperimentale par la Zoologia Agraria, Firenze, Italia; Dr F. Pegazzano
- SAM South Australian Museum, Adelaide, Australia; Mr D. C. Lee
- UAM Uniwersytet im A Mickiewica, Instytut Biologii, Poznan, Poland; Dr M. Kalizewski
- UMC University of Missouri Columbia, Missouri, U.S.A.; Dr W. R. Enns
- USNM National Museum of Natural History, (formerly United States National Museum), Smithsonian Institution, Washington, D.C., Dr E. W. Baker.
- ZMA Instituut voor Taxonomische Zoologie (Zoological Museum), University of Amsterdam, The Netherlands; Dr J. P. Duffels

I am grateful to Prof Dr W. Helle for his help and comments during the preparation of this manuscript. Thanks are due to Dr M. K. P. Smith-Meyer and to Prof Dr U. Gerson for helpful suggestions, critical remarks and the latter also for placing the scanning electron microscopic micrographs of *Decaphyllobius gersoni* spec. nov. at my disposal.

CAMEROBIIDAE Southcott, 1957

Type species: *Camerobia australis* Southcott, 1957.

Description.

Body small, 210—400 μm , broadly oval or rounded, dorso-ventrally flattened, greatest

width in front of coxae III, without a sejugal furrow. Mites coloured with haemolymph pigments, probably carotenoids, giving a yellowish, greenish, brownish or reddish appearance. Midgut often visible from above as a white medial tape in opisthosoma. Body weakly sclerotized and cuticle wrinkled. On dorsum, areas with fine striation patterns can be recognized, often separated from each other by longitudinal or transverse bands, of coarse striae.

Two double-lensed eyes are always present lateral to the line between the third and fourth dorso-lateral setae (= *l*). There are nine to ten pairs of *l* setae and five to six pairs of dorso-central setae (= *mc*). The shape of the dorsal setae ranges from short palmate to very long whip-like. Dorsal setae placed on small or large tubercles. Setae *l*₅ always located anterior to coxae III. One short, supra-coxal seta situated lateral to *l*₂.

There are three pairs of ventral setae. In addition, there are two pairs of genital and three pairs of anal setae. Ventrally, close to the palp basis, is a pair of hardly discernible coxal setae. The legs are often stilt-like, because of an elongation of the femora and tibiae. The genua are relatively short. The coxae are arranged into two groups, with a space between coxae II and III.

Coxae I—IV with a setal formula of 3-1-2-2 setae. Trochanters with no or one seta. Femora with one to six setae, depending on the species. Genua with one or two setae; genua I and II each with a solenidion distal to the setae (fig. 33).

Tibiae with different numbers of setae, ranging from six to nine. Numbers and location of tibial setae are of generic significance. Very often, a distally located solenidion is present. Tarsi with different numbers of setae, ranging from six to ten. Two of the distal setae are always bifid. One, exceptionally two solenidia are present on tarsi I and II. The empodium, between the two claws, is pad-like, provided with two rows of capitate tenent hairs.

The small gnathosoma is almost covered by the anterior flap of the prodorsum. Basal parts of the chelicerae fused; stylets short, dagger-like and movable. Tortuous peritremata arise on the dorsum of the gnathosoma and consist of one, two or four almost complete loops; pedipalps divided into five segments with the following setation: trochanter without seta, femur has two

setae, genu one seta and tibia two to four setae. One of the tibial setae is sword-like and is probably a vestigial palptibial claw. Tarsus with one or two setae. In addition, palptarsus with one solenidion and one or two eupathidia.

Developmental stages.

Larva hexapod. *Mc*₁ lacking. Only two pairs of ventral and three pairs of anal setae. Coxa I with one seta, II and III without setae.

Protonymph octopod. Setae on coxa IV and trochanter IV lacking.

Deutonymph in size and setation roughly similar to adult. The genual setae often longer than in the adult. Many authors, not aware of the existence of two separate nymphal stages, use the word "nymph" instead of protonymph.

History.

The genus *Neophyllobius* was classified in the family Tetranychidae by Berlese (1886), Canestrini (1890), Geijskes (1939) and Womersley (1940). On the contrary McGregor (1950) placed it in the Stigmaeidae; Baker & Wharton (1952) in the Raphignathidae; Summers & Schlinger (1955), Meyer & Ryke (1959), Atyeo (1961), Meyer (1962), Wood (1964) and Chaudhri (1974) in the Calligonellidae.

Southcott (1957) erected two separate families, viz., Neophyllobiidae and Camerobiidae. This practice was followed by De Leon (1958, 1959, 1967), Soliman & Zaher (1967), Summers (1966), Gerson (1968), Smiley & Moser (1968), Krantz (1970), Livshits & Mitrofanov (1975, 1980) and Zaher & Gomaa (1979). Gerson (1972) pointed out that two of the characters used to separate these two families i.e. the palmate dorsal body setae and the absence of ultra-long setae on the genua, are inconsistent and that the third one, the presence of a camerosome, is invalid. Therefore he synonymized Neophyllobiidae with Camerobiidae and placed *Neophyllobius* in the latter family. This concept had been followed by Robaux (1975), Kuznetsov & Livshits (1979), Kethley (1982), Krantz (1978) and Bolland (1983).

Diagnosis.

The Camerobiidae are separated from other raphignathoid families by their long legs having elongate femora and tibiae, by the location of the peritremata, by the fused chelicerae, by the location of the anal area, by the position of the coxal fields and by the absence of a sejugal fur-

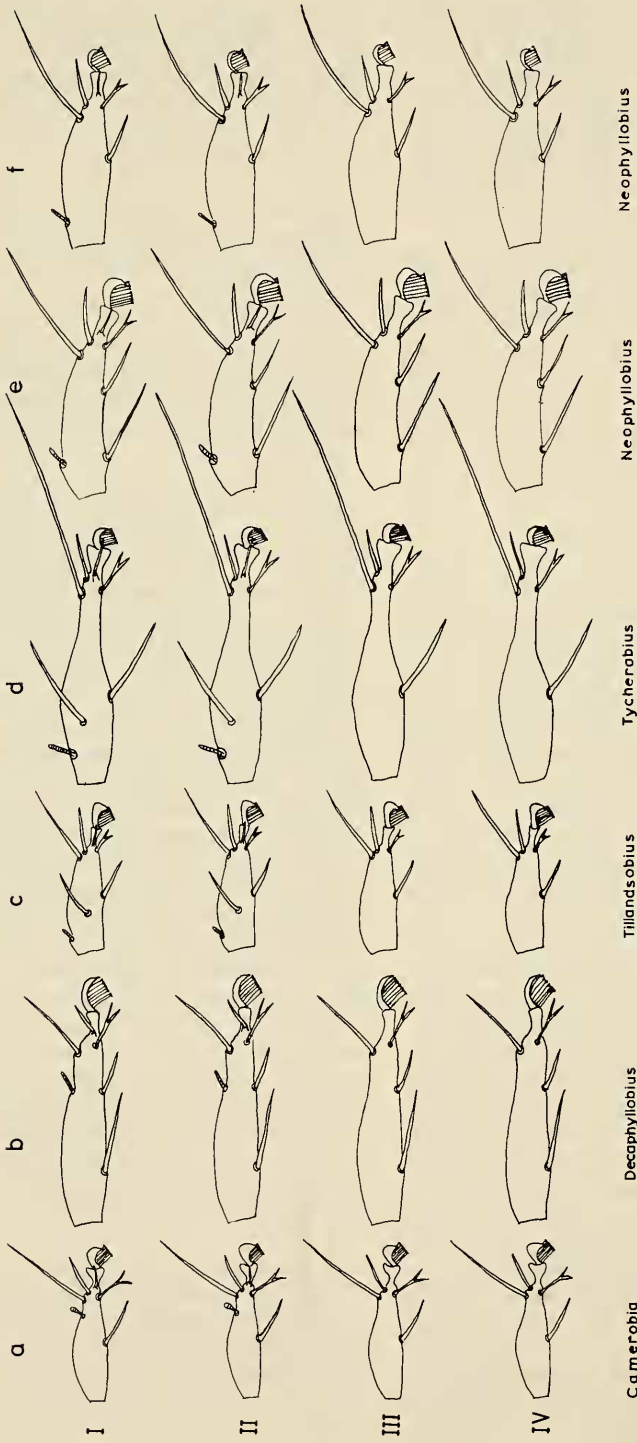


Fig. 1 a—f. Schematic variation in setal pattern of tarsi I—IV and the position of the solenidia on tarsi, in the genera *Camerobia*, *Decaphyllobius*, *Tillandsobius*, *Tycherobius* and *Neophyllobius* of the family Camerobiidae.

row. A whip-like seta is often present on the short genua. The palptibia bears a "long sword-like" seta instead of a short "thumbclaw".

KEY TO THE GENERA OF CAMEROBIIDAE
(based on females)

1. Solenidion on tarsi I and II situated distally (fig. 1a/b) 2¹⁾
- Solenidion on tarsi I and II situated proximally (fig. 1c—f) 3
2. Dorsum with nine *l* setae; tibial setal formula I—IV: 7 (6)—6-6-6; trochanter I without setae (fig. 9) *Camerobia* Southcott
- Dorsum with ten *l* setae; tibial setal formula I—IV: 8-7-7-7; trochanter I with one seta (fig. 25) *Decaphyllobius* gen. nov.
3. Tibial setal formula I—IV: 8-7-6-6 (fig. 40); two medio-ventral setae on tarsi I and II not placed in a longitudinal line (fig. 1c)
..... *Tillandsobius* gen. nov.
- Tibial setal formula I—IV: 9-8-7-7 (fig. 49); two medio-ventral setae on tarsi I and II not placed in a longitudinal line (fig. 1d)
..... *Tycherobius* gen. nov.
- Tibial setal formula I—IV: 9-8-8-7; one or two medio-ventral seta(e) on tarsi I and II. If two setae present, the setae placed in a longitudinal line (fig. 1e)
..... *Neophyllobius* Berlese

***Camerobia* Southcott, 1957**

Camerobia Southcott, 1957: 306—312.

Type species: *Camerobia australis* Southcott, 1957.

Dorsum with 15—17 pairs of short and round to budlike setae, with a short stalk and placed on small tubercles. The *mc*₁ setae are placed on the same transversal level as the *l*₃ setae. Dorsum with a rough striation pattern laterally and finer transversal striae mediad. Peritremata consist of four almost complete loops. Trochanter I without setae. Genua setae short. Tibiae with six or seven setae of two types. Each tibia also has a long solenidion on the distal end.

All tarsi with only one mid-ventral seta. Tarsi I and II have seven and tarsi III and IV six distal setae of which two are always bifurcated. Tarsi I and II have a solenidion at their distal half.

Palptibiae with one seta and a sword-like seta, palptarsi with one seta, one eupathidium and a solenidion.

Key to the species of *Camerobia*

1. Femur I with six setae (fig. 9) 2
- Femur I with five setae (fig. 4) *C. australis*
2. Femur III with four setae; tibia I with seven setae (fig. 19) 3
- Femur III with three setae; tibia I with six setae (fig. 9) *C. pistaciae* spec. nov.
3. Dorsum without sub-lateral setae; bush-like *C. southcotti*
- Dorsum with two pairs of sub-lateral setae; bud-like *C. monspeliensis* spec. nov.

***Camerobia australis* Southcott**

(figs. 2—6)

Camerobia australis Southcott, 1957: 306—312.

Female: Body length 295 (250)µm, width 275 (220)µm. Length of legs: (295; 265; 270; 320 µm). Six pairs of *mc* and nine pairs of *l*; 18—25 (all 15) µm long and 12—20 (5) µm wide. Inter-setal distances: *l*₁-*l*₂; *l*₂-*l*₃; *l*₃-*l*₄ = (25; 45; 30 µm). Leg setation: coxae 3-1-2-2, trochanters 0-1-1-1, femora 5-4-2-2, genua 1-1-1-1, tibiae 6-6-6-6, tarsi 8-8-7-7. Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 1 + 1 sword-like seta, tarsus 1 + 1 eupathidium.

The dorsal setae are much smaller than those of *C. southcotti* Gerson, and their width is about one third of their length. There is only one seta on the distal end of each femur; *C. southcotti* has two setae on each femur in a transverse row on the distal end.

Male: Unknown.

Material examined: Paratype ♀, Australia, Queensland, Kaban, Atherton Tableland, under bark of *Eucalyptus* sp., 24.viii.1944, R. V. Southcott (CS no. ACC 330).

Other published material: Holotype ♀, Australia, Tableland, Kaban, Atherton, under bark of *Eucalyptus* sp., 24.viii.1944, R. V. Southcott (CS no. ACC 329). Paratypes: 1 ♀, South Australia, Glen Osmond, under bark of *Eucalyptus camaldulensis*, 17.iii.1937, R. V. Southcott (CS no. ACC 331); 1 ♀, Australia, Grovely near Brisbane, probably from *Eucalyptus* sp., 25.viii.1945, R. V. Southcott (CS no. ACC 332).

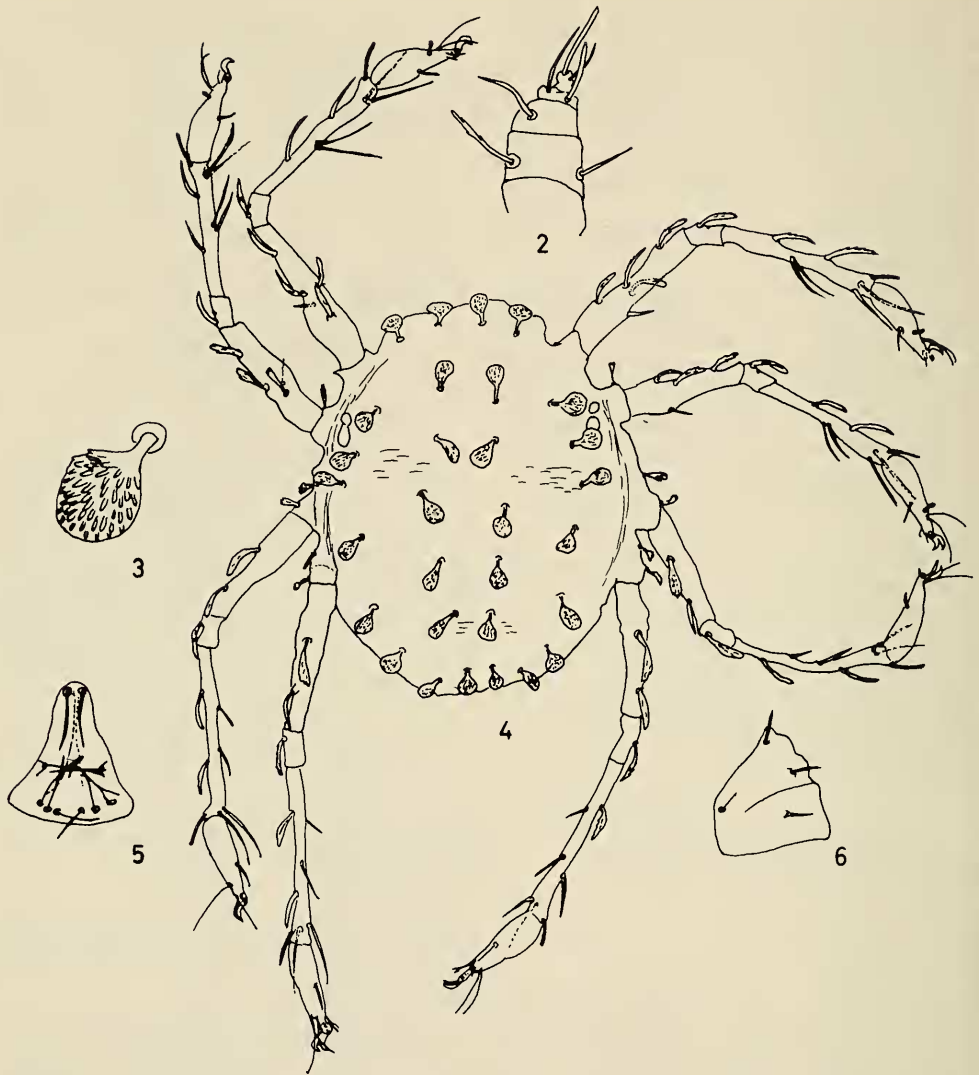
***Camerobia pistaciae* spec. nov.**

(figs. 7—12)

Camerobia australis Southcott; Szabó, 1980: 376. Misidentification.

Female: Body length 280 µm, width 240 µm. Length of legs: 280; 265; 275; 280 µm. Six pairs of *mc*: 30; 30; 30; 30; 30; 25 µm. Nine pairs of *l*:

¹⁾ See discussion under *Neophyllobius hadros*.



Figs. 2—6. *Camerobia australis* Southcott, ♀. 2, pedipalp; 3, dorsal seta; 4, dorsal view; 5, genital-anal region; 6 coxae I and II.

25; 25; 25; 30; 30; 30; 30; 25; 25 μm . All dorsal setae are 25—30 μm wide. Inter-setal distances: l_1-l_2 ; l_2-l_3 ; l_3-l_4 = 30, 30, 30 μm . Leg setation: coxae 3-1-2-2, trochanters 0-1-1-1, femora 6-5-3-3, genua 1-1-1-1, tibiae 6-6-6-6, tarsi 8-8-7-7. Pedipalp setation; trochanter 0, femur 2, genu 1, tibia 1 + 1 sword-like seta, tarsus 1 + 1 eupa-

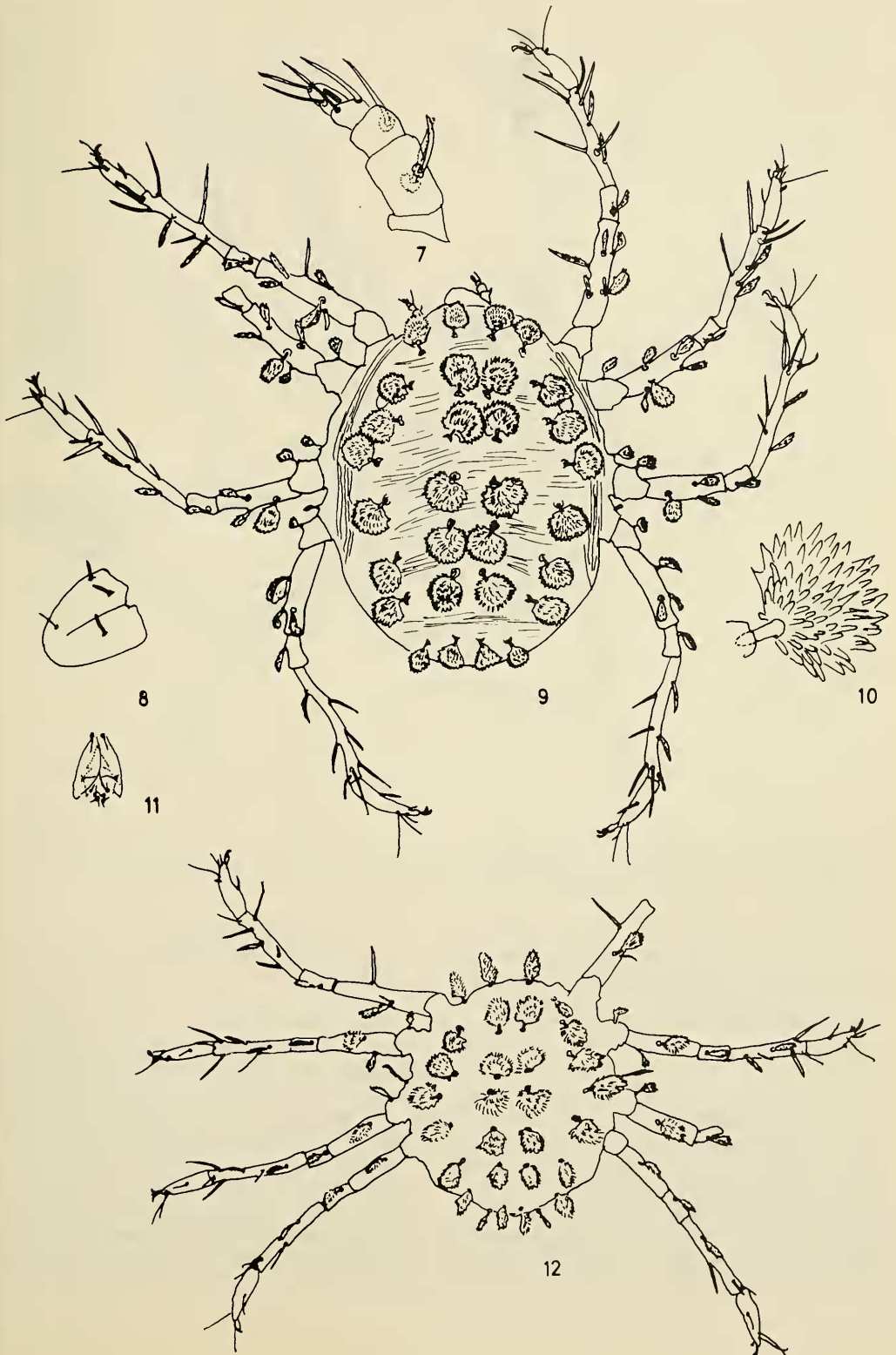
thidium. The genual setae are short. The dorsal setae are more or less palmate, spiculate and basically with a small stalk.

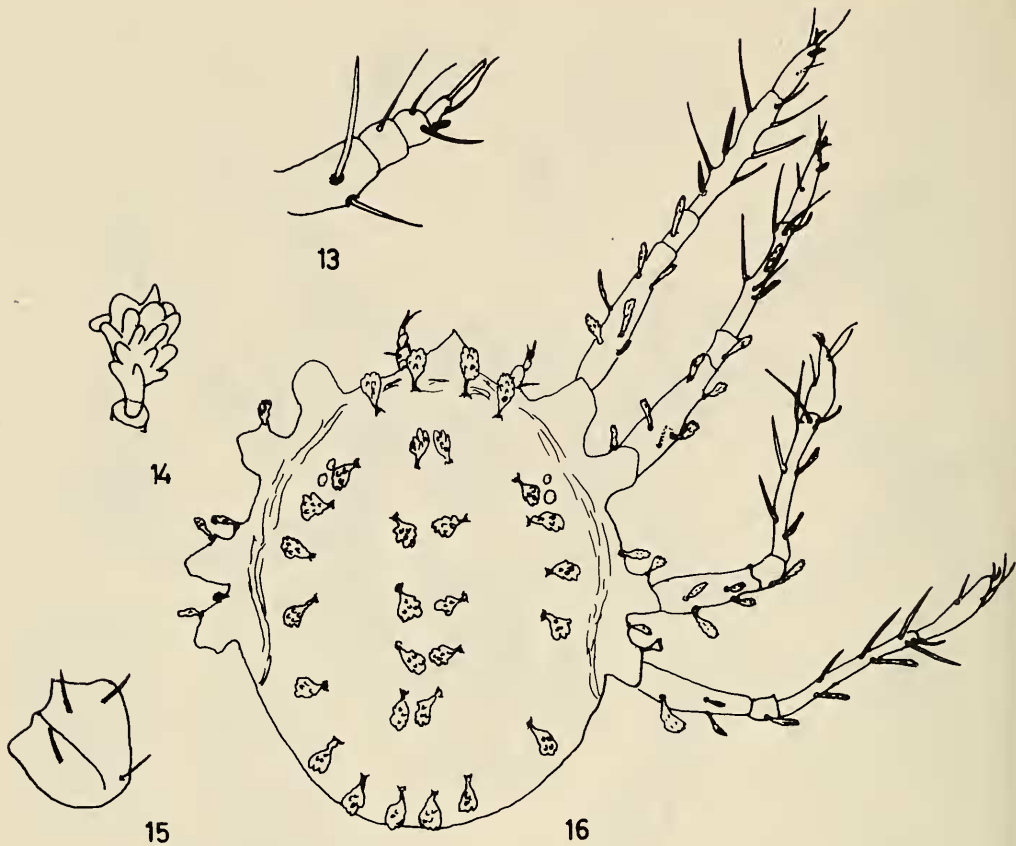
Each femur has two setae on a transversal level at the distal end.

Male: Unknown.

Protonymph: Six pairs of *mc*. Nine pairs of *l*.

Figs. 7—12. *Camerobia pistaciae* spec. nov., ♀. 7, pedipalp; 8, coxae I and II; 9, dorsal view; 10, dorsal seta; 11, genital-anal region; protonymph. 12, dorsal view.





Figs. 13—16. *Camerobia southcottii* Gerson, ♀. 13, pedipalp; 14, dorsal seta; 15, coxae I and II; 16, dorsal view.

Leg setation: coxae 3-1-2-0, trochanters 0-1-1-0, femora 3-2-1-1, genua 1-1-1-1, tibiae 5-5-5-3, tarsi 1-1-1-1 (mid-ventral), distal parts of tarsi indistinct.

Type material: Holotype ♀, Israel, Zikhron Yaakov, on *Pistacia* branches, 23.xiii.1981, U. Gerson (ZMA). Paratypes: 2 protonymphs same data as holotype; 1 ♀, Hungary, Szarvas, on *Corylus avellana*, 14.x.1979, P. Szabó (CAU).

Remarks. The Hungarian specimen was studied from photographs taken by Dr P. Szabó. This specimen does not belong to *C. australis* but is conspecific with the holotype of *C. pistaciae*. This species differs from *C. australis* by having six setae on femur I instead of five. The dorsal setae are longer and wider (25/30 µm) than those of *C. southcottii* and are more spicu-

late. In contrast to *C. southcottii*, *C. pistaciae* has femur III with three setae and tibia I with six setae.

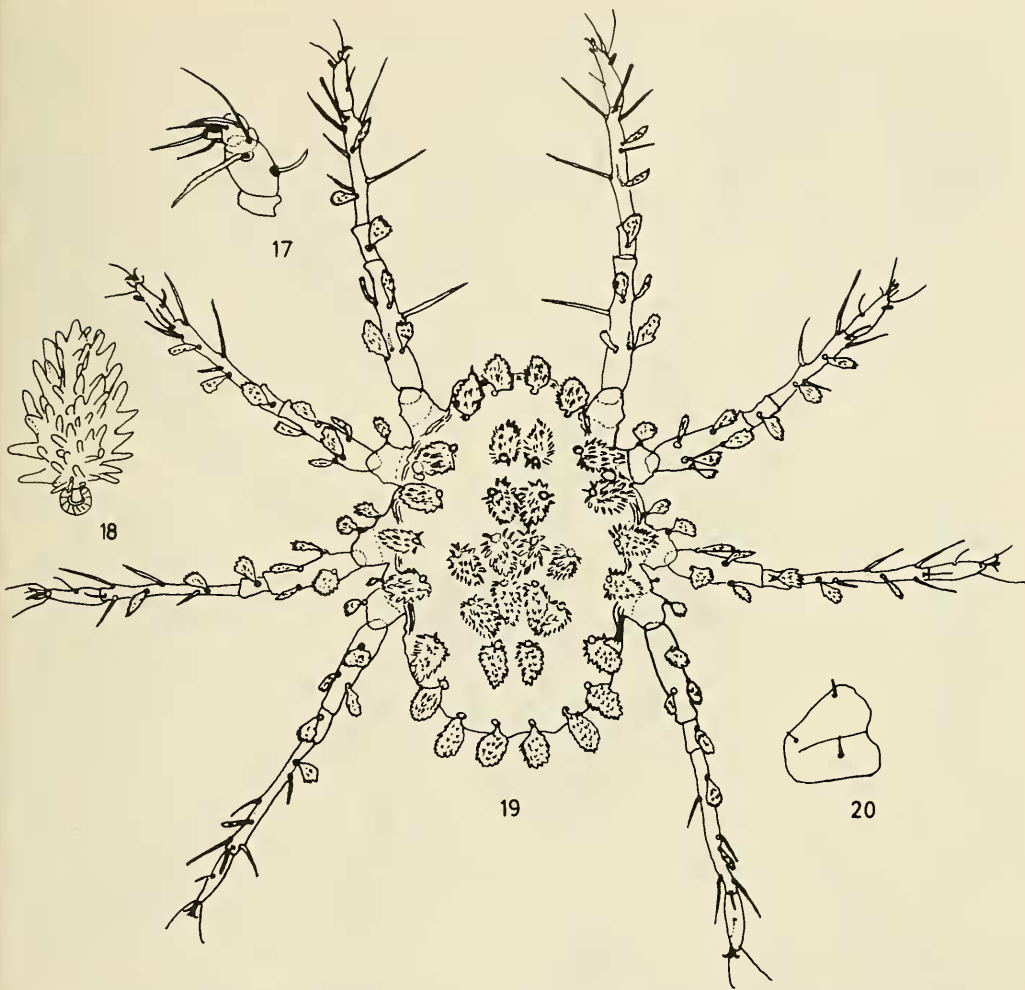
Camerobia southcottii Gerson

(figs. 13—16)

Camerobia southcottii Gerson, 1972: 502—508.

Female: Body length 265 (262) µm, width 235 (227; 231) µm. Length of legs: 280; 250; 255; 270 µm. Six pairs of *mc*: 20; 20; 20; 20; 20; 20. Nine pairs of *l*: 25; 25; 20; 20; 20; 20; 20; 20; 20 µm. All dorsal setae are 15 µm wide. Inter-setal distances: l_1-l_2 ; l_2-l_3 ; l_3-l_4 = 20, 30, 25 µm.

Leg setation: coxae 3-1-2-2, trochanters 0-1-1-1, femora 6-5-4-3, genua 1-1-1-1, tibiae 7-6-6-6, tarsi 8-8-7-7. Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 1 + 1 sword-like setae, tarsus 1 + 1 eupathidium. The genual setae are short. The dorsal setae are bushlike, spiculate,



Figs. 17—20. *Camerobia monspeliensis* spec. nov., ♀. 17, pedipalp; 18, dorsal seta; 19, dorsal view; 20, coxae I and II.

and basally with a small stalk. Each femur has two setae in a transverse row at the distal end.

Male: Unknown.

Material examined: Holotype ♀, Israel, Montfort, on *Pistacia* tree, 31.iii.1970, U. Gerson (HUJ no. 2300).

Other published material: Paratypes: 1 ♀ (USNM); 1 ♀ (SAM no. ACC 866), both same collection data as holotype.

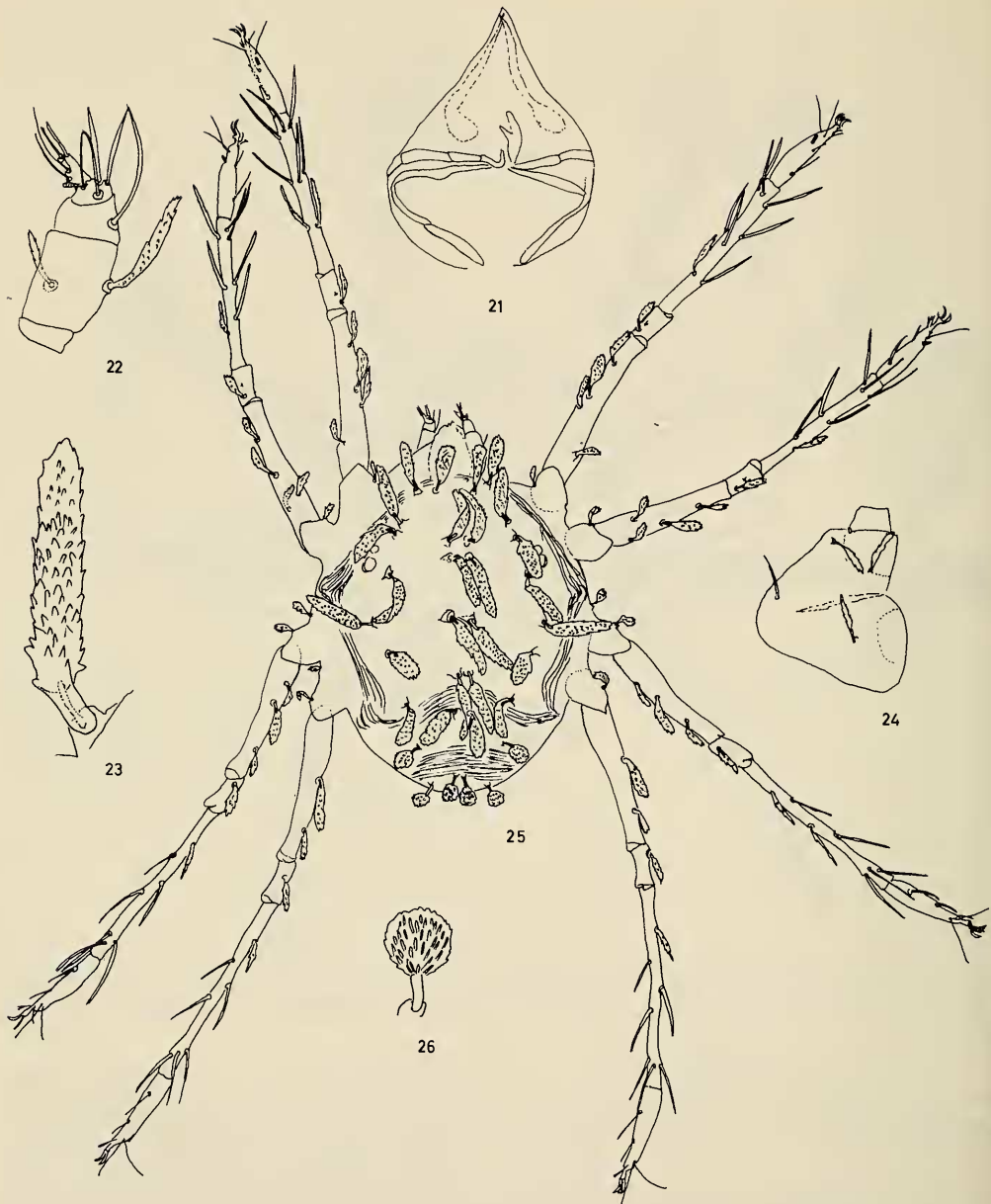
Remarks. According to Gerson (1972) this species has four setae on femur III and seven setae on tibia I, which are different in *C. pistaciae* spec. nov.

The dorsal setae are shorter and smaller ((11—12); (13—14); (15—17)) μm than those of *C. pistaciae* spec. nov. and are less spiculate.

This species differs from *C. australis* in having six setae on femur I instead of five and seven setae on tibia I instead of six. The dorsal setae are more rounded and larger. Also the location of the femoral setae is different in both species.

Camerobia monspeliensis spec. nov.
(figs. 17—20)

Female: Body length 250 μm , width 193 μm . Length of legs: 271; 240; 259; 271 μm . Six pairs of *mc*: all 31 μm . Nine pairs of *l*: 28; 28; 31; 31; 31; 31; 31; 31; 31 μm .



Figs. 21—26. *Decaphyllobius gersoni* spec. nov., ♀. 21, peritremata and stylets; 22, pedipalp; 23, dorsal seta; 24, coxae I and II; 25, dorsal view; 26 caudal-dorsal seta.

Two pairs of sub-lateral setae (= *sl*): 31; 31 μm . All dorsal setae are, at widest point, 16 μm wide. Inter-setal distances: l_1-l_2 ; l_2-l_3 ; l_3-l_4 = 30, 30, 20 μm . Leg setation: coxae 3-1-2-2, trochanters 0-1-1-1, femora 6-5-4-3, genera 1-1-1-

1, tibiae 7-6-6-6, tarsi 8-8-7-7. Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 1 + 1 sword-like seta, tarsus 1 + 1 eupathidium. The genual setae are short. The dorsal setae are more budlike, spiculate and with a small stalk. Each

femur has two setae in a transverse row on the distal part.

Male: Unknown.

Type material: Holotype ♀, France, Montpellier, on *Platanus acerifolia* Willd., 28.xi.1985, H. R. Bolland (ZMA).

Remarks. This species can be differentiated from the three other *Camerobia* species, by having two pairs of sub-lateral setae (= *sl*) on the opisthosoma. It is the only species in the family Camerobiidae which possesses these *sl* setae. *Camerobia monspeliensis* has seven setae on tibia I and four setae on femur III, resembling *C. southcottii*.

Decaphyllobius gen. nov.

Type species: *Decaphyllobius gersoni* spec. nov.; by present designation.

Dorsum with 16 pairs of setae. There is an extra pair of l_1 setae (l_{1A}). L_2 and l_3 setae are closer together than l_1 and l_2 . Mc_1 and mc_2 are close to each other and posterior to level of l_3 . Peritremata consist of two almost complete loops. Trochanters I—IV each with one seta. There are one or two (see *Neophyllobius agrifoliae* McGregor) short, genual setae. Tibia I with eight whereas other tibiae have seven setae. A solenidion at the distal end of the tibiae is not always present. Tarsi I and II each with a solenidion on distal half (see discussion under *Neophyllobius hadros* Chaudhri). Palptibiae with three setae and a sword-like seta, palptarsi with two setae, two eupathidia and a solenidion.

Decaphyllobius gersoni spec. nov.

(figs. 21—36)

Female: Body length 310 (300—305) μm , width 280 (255—285) μm . Length of legs: 495; 435; 490; 525 (500—545; 450—500; 500—550; 560—565) μm .

Six pairs of *mc*: 60; 60; 65; 60; 40; 30 (55; 60; 75; 70; 50; 30) μm . Ten pairs of *l*: 45; 45; 60; 50; 60; 70; 40; 45; 30; 35 (35—45; 35—45; 50—55; 45—50; 55; 60—65; 30—35; 35—40; 30—35; 25) μm . Inter-setal distances: l_1 - l_2 ; l_2 - l_3 ; l_3 - l_4 = 35; 10; 40 μm . Leg setation: coxae 3-1-2-2, trochanters 1-1-1-1, femora 4-4-3-2, genua 1-1-1-1, tibiae 8-7-7-7, tarsi 8-8-6-6. Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 3 + 1 sword-like seta, tarsus 2 + 2 eupathidia. The solenidia on tarsus I and II are situated on the distal part of each tarsus. Tarsi I—IV all with two setae in a ventral position, see figure 1b.

Tibiae I—IV devoid of solenidia. There are two different types of setae on the dorsum: broadly lanceolate and spatulate (l_8 , l_9 and mc_6). All dorsal setae with a stalk, located on tubercles. From the outer margins a band of coarse striae is present posterior to l_7 and curves anterior to mc_5 , rest of posterior part of opisthosoma also covered by coarse striae.

Male: Body smaller, mc_6 reduced in length.

There is only one solenidion on the distal end of tibia I, whereas most males of the Camerobiidae have two. All four tarsi have basically a male solenidion. There are no ventral genital setae but four pairs of anal setae.

Protonymph: Six pairs of *mc* setae and ten pairs of *l* setae. Leg setation: coxae 3-1-2-0, trochanters 1-1-1-0, femora 3-2-1-1, genua 1-1-1-1, tibiae 5-5-5-3, tarsi 1-1-1-1 (mid-ventral); setae at distal end of tarsus indistinct. One short solenidion at distal end of tibia I. The "lay-out" of the solenidia on tarsi III—IV, which are placed in a more proximal position, strongly indicating that it is a male-protonymph. The dorsal setae are of a different shape than in the adult. SEM micrographs of a protonymph are given in figures 31—36.

Larva: Five pairs of *mc* setae; mc_1 absent. Nine pairs of *l* setae; l_2 absent. Leg setation: coxae 2-0-0, trochanters 0-0-0, femora 2-2-1, genua 1-1-1, tibiae 3-3-3, tarsi 1-1-1 (mid-ventral). Distal parts of tarsi indistinct. The solenidia on distal ends of tibiae I—IV are missing.

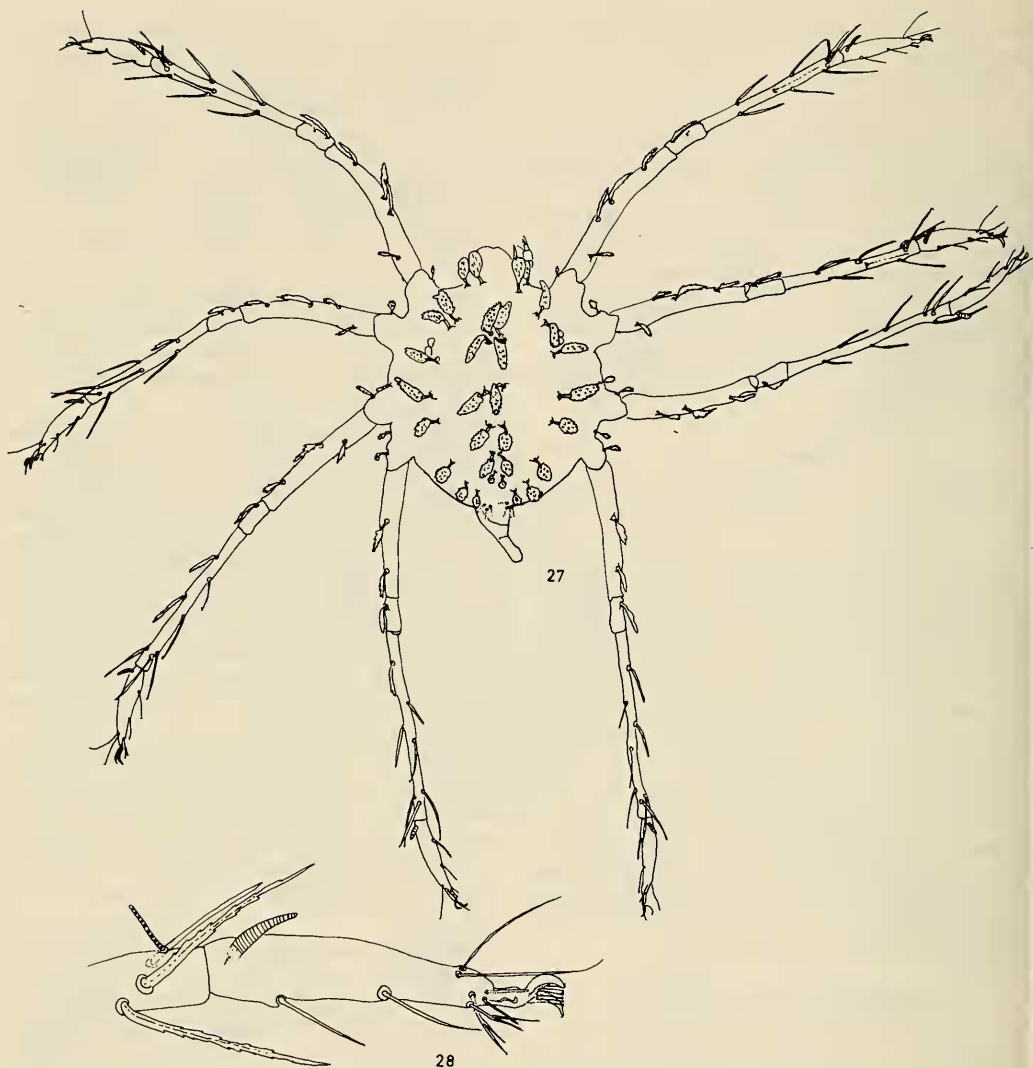
D. gersoni was found on galls of *Obdulia* sp. (Acari: Tenuipalpidae) on tamarisk trees. This species is named after Dr U. Gerson (HUJ).

Type material: Holotype ♀, Israel, Elat, on *Tamarix aphylla*, 23.v.1975, U. Gerson (HUJ no. 2764). Paratypes: allotype ♂ (HUJ no. 2763); 2 ♀ (HUJ no. 2769 and 2770); 1 (♂) protonymph (HUJ no. 2766); 1 larva (HUJ no. 2765), all with the same collection data as holotype.

The following three species are tentatively assigned to *Decaphyllobius*. Confirmation requires study of the type series.

Neophyllobius citri Soliman & Zaher, 1967: 27, 28, (♂ and ♀). Type material: the holotype ♀ and allotype ♂ were collected in Upper Egypt, Kom Ombo, on citrus trees, and are no longer present in the FAUC.

Neophyllobius agrifoliae McGregor, 1950: 56—58; McDaniel, 1979: 201, 202, pl. 386. Type material: holotype ♀, U.S.A., California,



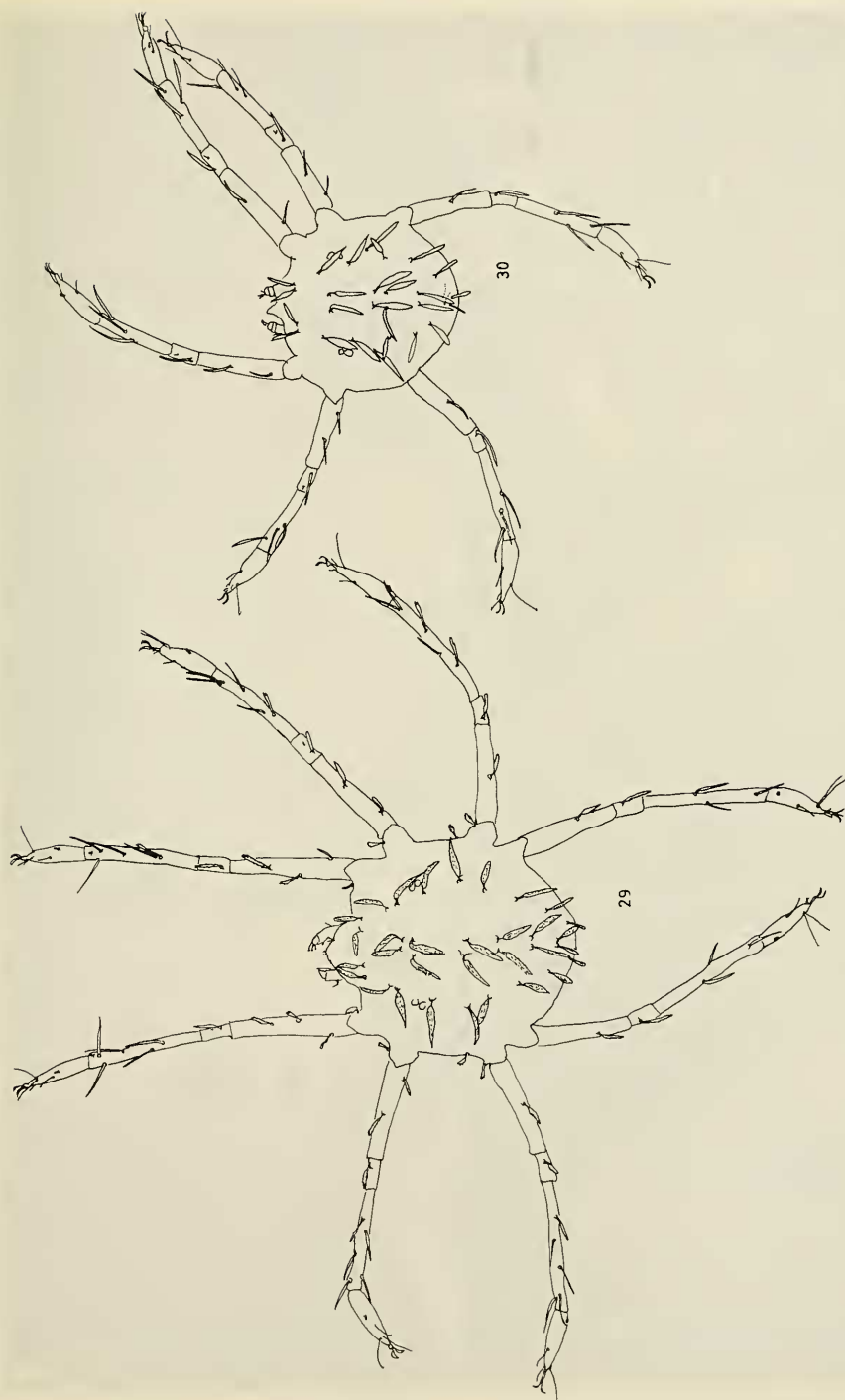
Figs. 27—28. *Decaphyllobius gersoni* spec. nov., ♂. 27, dorsal view; 28, tarsus I and distal part of tibia I.

South Pasadena, on *Quercus agrifolia*, 3.ix.1938, B. L. Boyden (USNM no. 1746, (1757?)). No specimen was present on the type slide. Plate 15 fig. 4 (McGregor, 1950) gives two setae on genua I—IV.

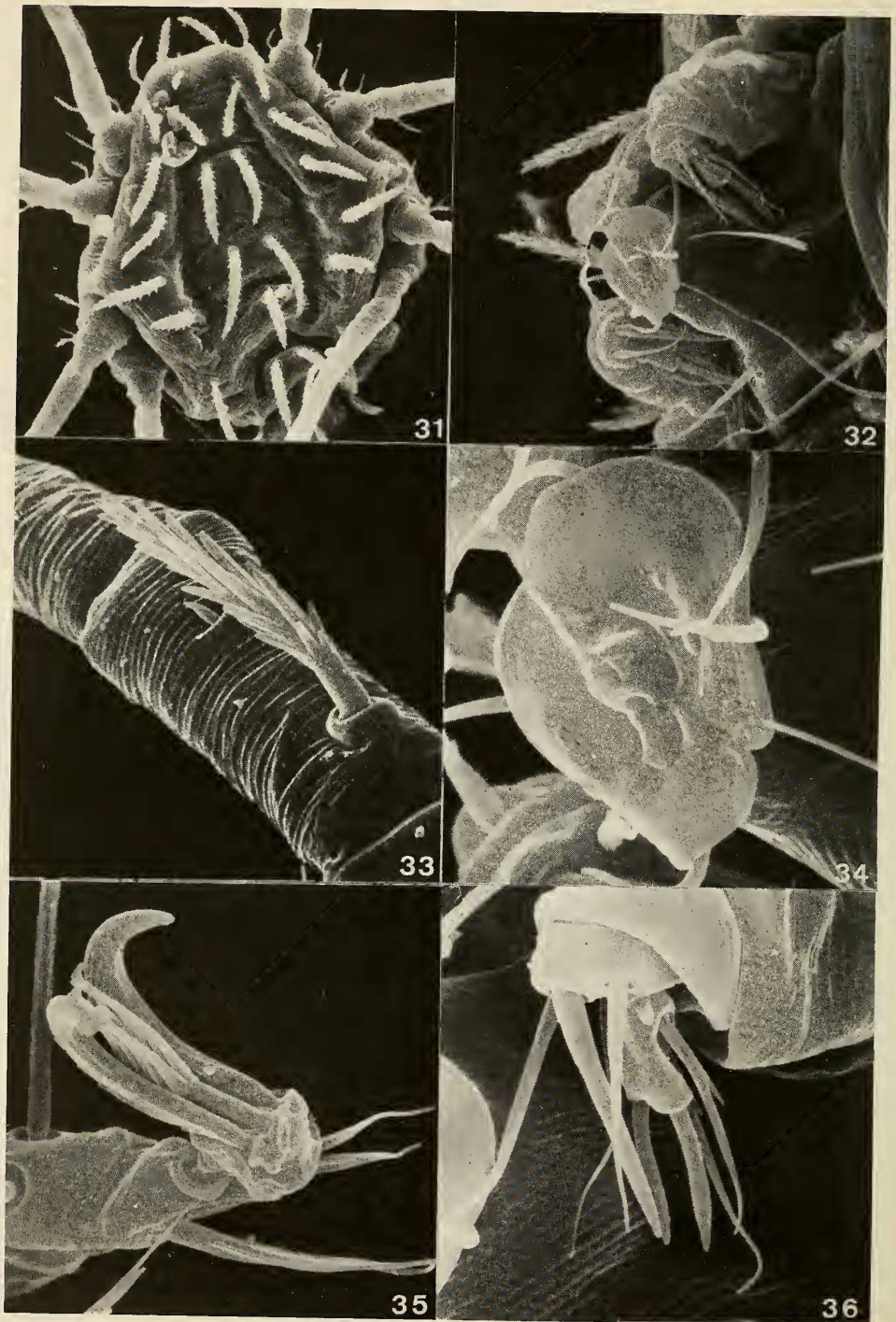
Neophyllobius hadros Chaudhri, 1974: 188—198. Type material: holotype ♀, Pakistan, Univ. Agric. Lyallpur, Campus, *Cyclops* spec., 4.iv.1971, W. M. Chaudhri (DEUAL). Paratype: 1 ♀, Pakistan, one mi. N. Vehari, *Salva-*

dora oleoides, 21.i.1972, W. M. Chaudhri (DEUAL).

Judging from the description by Chaudhri (1974), there are probably two solenidia on each of tarsi I and II. The distal one is important for genus recognition. According to the latter author the proximal solenidium is also present on tarsi I and II. It is noteworthy to mention that the presence of two solenidia on tarsi I and II is rare for the Camerobiidae.



Figs. 29—30. *Decaphyllobius gersoni* spec. nov., protonymph. 29, dorsal view; larva. 30, dorsal view.



Figs 31—36. *Decaphyllobius gersoni* spec. nov., protonymph. 31, dorsal view; 32, venter of gnathosoma; 33, genu I; 34, rostrum; 35, apotele IV; 36, pedipalp. 31, magnification 430 ×; 32, 2000 ×; 33, 3400 ×; 34, 7000 ×; 35/36, 5000 ×.

Tillandsobius gen. nov.

Type species: *Neophyllobius floridensis* McGregor, 1950; by present designation.

Dorsum with 15 pairs of setae. L_1 and l_2 are situated closer to each other than l_2 and l_3 . Mc_1 setae are placed close behind the line across bases of l_2 .

The four peritremata consist of two almost complete loops. Trochanters I—IV each with one seta. Genual setae short. Tibial counts 8-7-6-6. All tibiae each with a distal solenidion. Tarsi I and II each with a subbasical solenidion. Tarsi I and II each with two setae which are not both placed in a ventral position, see figure 1c. Tarsi III and IV each with one mid-ventral seta. Palptibiae with three setae and one sword-like seta. Palptarsi with one seta and two eupathidia and a solenidion.

Tillandsobius floridensis

(McGregor) comb. nov.
(figs. 37—45)

Neophyllobius floridensis McGregor, 1950: 61.

Female: Body length 285 (285—305) μm , width 205 (205—235) μm . Length of legs: 345 (345—375); 285 (285—295); 310 (310—360); 350 (350—375) μm . Six pairs of mc : 20 (20); 15 (15—20); 15 (15—20); 20 (20—25); 20 (20—30); 20 (20—30) μm . Nine pairs of l : 30 (30—35); 20 (20—30); 15 (15—20); 15 (15—20); 20 (20—30); 20 (20—25); 20 (20—25); 20 (20—30); 20 (15—25) μm . Inter-setal distances: l_1 - l_2 ; l_2 - l_3 ; l_3 - l_4 = 10; 35; 30 μm . Leg setation: coxae 3-1-2-2, trochanters 1-1-1-1, femora 4-3-2-2, genua 1-1-1-1, tibiae 8-7-6-6, tarsi 10-10-7-7.

Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 3 + 1 sword-like seta, tarsus 1 + 2 eupathidia.

Mc_1 setae are placed behind the line across bases of l_2 .

Anterior two thirds of dorsum outlined by a narrow band of coarse striae, other bands of coarse striae on the dorsum are between l_7 - l_7 and between l_8 - l_8 , but the latter does not touch the l_8 setae; rest of posterior part of dorsum also covered with finer longitudinal striae; whole dorsum irregularly punctate. Tarsi I and II with two ventral setae, not in a line with each other but variously spaced. Tarsi III and IV with only one mid-ventral seta.

Male: smaller than female: Mc_6 shortened in length. Only the male solenidion could be observed on each tarsi I and IV, because other tarsi

were broken off. There are two solenidia on the distal end of tibia I.

Protonymph: Six pairs of mc . Nine pairs of l . Setation of legs: coxae 3-1-2-0, trochanters 1-1-1-0, femora 3-2-1-1, genua 1-1-1-1, tibiae 4-4-4-2, tarsi 1-1-1-1, medio-ventral. Distal parts of tarsi indistinct.

Larva: Five pairs of mc . Nine pairs of dorso-laterals. Setation of legs: coxae 2-0-0, trochantera 0-0-0, femora 2-2-1, genua 1-1-1, tibiae 2-2-2, tarsi 1-1-1, medio-ventral. Distal parts of tarsi indistinct. The coarse striation band occurs transversad behind mc_3 instead of behind mc_4 as in the adult.

Remarks. On one side of a paratype δ (in USNM) two mid-ventral setae are present on tarsus III, but only on one side. One paratype η (in UMC) also has two mid-ventral setae on one side of tarsus III.

Material examined: Holotype η , USA, Florida, Duval County, Dupont road, Spanish moss, 9.ii.1948, D. C. Thurman (USNM no. 1897). Paratypes: allotype δ and 2 δ , same slide and data as for the holotype (USNM no. 1897); 1 η and 1 larva, USA, Louisiana, St. Landry Parish, two mi. N. Melville, Spanish moss, 2.i.1972, L. Dureseau (UMC); 2 protonymphs, USA, Florida, Haines City, Spanish moss under Australian pine, 22.iii.1968, H. L. Greene (DCDG).

Tycherobius gen. nov.

Type species: *Neophyllobius lombardinii* Summers & Schlinger, 1955; by present designation.

Dorsum with nine pairs of l setae. Five pairs of mc setae, mc_2 - mc_6 (only *Neophyllobius rhytis* Chaudhuri has six pairs of mc setae; *Tycherobius virginienis* comb. nov. has five pairs, plus a single mc_1 seta). The four peritremata consist of two almost complete loops. Trochanters I—IV each with one seta. Tibiae with 9-8-7-7 setae, scattered all over the segment. All tibiae with a distal solenidion. Tarsi I and II each with a subbasical solenidion. The tarsi are skittle-shaped (fig. 1d). Tarsi I and II each with two variously spaced setae (fig. 1d). Tarsi III and IV only with one medial seta. Palptibiae with three setae and a sword-like seta. Palptarsi with one or two setae, one eupathidium and a solenidion.

Key to the species of the genus *Tycherobius*

- Five pairs of mc setae; coarse transverse striae banded behind mc_2 2

- More than five pairs of *mc* setae 5
- 2. Mc_4 approx. same length of mc_3 3
- *T. lombardinii* comb. nov.
- Mc_4 shorter in length than mc_3 3
- 3. Mc_4 approx. $\frac{1}{2}$ of the length of mc_3 4
- Mc_4 approx. $\frac{1}{4}$ of the length of mc_3 4
- *T. superbus* comb. nov.
- 4. Palptarsi with one seta; l_3 shorter than l_1 3
- *T. stramenticola* spec. nov.
- Palptarsi with two setae; l_3 longer than l_1 3
- *T. polonicus* spec. nov.
- 5. Eleven *mc* setae, mc_1 represented by an unpaired seta; coarse transverse striae banded behind mc_5 *T. virginiensis* comb. nov.
- Six pairs of *mc* setae . . . *T. rhytis* comb. nov.

Tycherobius lombardinii

(Summers & Schlinger) comb. nov.
(figs. 46—49)

Neophyllobius lombardinii Summers & Schlinger, 1955: 550, 551, 560; MacDaniel, 1979: 202.

Female: Body length 280 (285) μm , width 235 (240) μm . Length of legs: 625 (570); 520 (475); 560 (530); 645 (610) μm . Five pairs of *mc*: 185 (170); 170 (165); 155 (100); 45 (45); 40 (35) μm . Nine pairs of *l*: 85 (70); 55 (40); 45 (35); 35 (30); 70 (55); 40 (30); 55 (40); 40 (40); 40 (35) μm . Inter-setal distances: l_1 - l_2 ; l_2 - l_3 ; l_3 - l_4 = (30; 30/35; 60 μm). Leg setation: coxae 3-1-2-2, trochanters 1-1-1-1, femora 4-3-3-2, genua 1-1-1-1, tibiae 9-8-7-7, tarsi 10-10-7-7. Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 3 + 1 sword-like seta, tarsus 2 + 1 eupathidium. From the outer margin a band of coarse striae runs medially behind l_5 and curves anteriorly behind mc_2 , to rejoin the margin behind l_5 .

Similar bands behind l_7 - mc_3 - l_7 , l_7 - mc_4 - l_7 and l_8 - mc_5 - l_8 . The members of the pair of setae, situated near the tips of the tarsi, vary considerably in length. The length of setae on femora II and III is characteristic of this species. Mc_2 , mc_3 and mc_4 long and mc_5 and mc_6 short. The dorsal setae are strongly serrated.

Male: Unknown.

Material examined: Paratypes: ♀, USA, California, Glendale, oak leaf mold, 1.i.1951, E. I. Schlinger (USNM no. 3); ♀, USA, California, The Gavilan, Riverside.

Other published material: Holotype ♀, USA, California, Glendale, oak leaf mold, 1.i.1951, Schlinger (USNM no. 2200). Paratypes: 2 ♀, with same data as holotype; 11 ♀, USA, Cali-

fornia, The Gavilan, Riverside, 17.v.1951, E. I. Schlinger (USNM).

Remarks. McDaniel (1979, fig. 387) depicted a species with different body and leg setation as that shown in the original description.

T. lombardinii can be distinguished from other members of this genus by the strongly serrated body setae and the relative length of the *mc* setae: mc_2 , m_3 and mc_4 long, mc_5 and mc_6 short. Another distinctive feature is the length of the setae on femora II and III.

Tycherobius superbus

(Canestrini) comb. nov.

Neophyllobius superbus Canestrini, 1889: 523—524; Canestrini, 1890: 459, 460, Tav. 39, fig. 44, Tav. 40, fig. 39; Berlese, 1894: fasc. 71, Tav. 3; Berlese, 1900: 289.

Female: Body length 270—290 μm , width 220 μm . Length of legs: 500 μm . Five pairs of *mc*: mc_2 = 140 μm , mc_3 = 115 μm . Nine pairs of *l*. Leg setation: coxae ?, trochanters 1-1-1-1, femora 3-3-2-2, genua 1-1-1-1, tibiae 9-8-7-7, tarsi ? Pedipalp setation: trochanter 0, femur 2, genu 1, tibia ? + 1 sword-like seta, tarsus ? + ? (indistinct).

Mc_2 and mc_3 long, mc_4 of moderate length, mc_5 and mc_6 very short. The most proximal seta on femur IV does not reach the genu.

Male: Berlese (1894, 1900) mentioned a male, having five setae on femur I. It is probably a male of a different species.

Known material: Holotype ♀, Italy, Padova, Trentino, of unknown date. Paratypes: several ♀ and ♂; only one slide at ISZA [not examined].

Remarks. No material of this species was available for study. The description is based on the papers of Canestrini and Berlese, and by information provided by Dr. F. Peggazzano (ISZA). According to Canestrini (1889) the female has three setae on femur I, and the male five setae. However, it is an inconsistency if the numbers of setae on femur I are different in both sexes. Femur III further has two setae which is in contrast to the three found in other members of the genus.

T. superbus is characterized by having mc_2 and mc_3 long, mc_4 of moderate length and mc_5



Figs. 37—40. *Tillandsobius floridensis* (McGregor) comb. nov. ♀. 37, pedipalp; 38, dorsal seta; 39, coxae I—IV; 40, dorsal view.

and m_6 very short. The most proximal seta on femur IV does not reach the genu, as in *T. lombardini*, *T. stramenticola* spec. nov. and *T. polonicus* spec. nov. Figure 19 (page 33) by Livshits & Mitrofanov (1980), is not of *T. superbus*, because there are six pairs of mc and a different number of tibial and tarsal setae.

***Tycherobius stramenticola* spec. nov.**
(figs. 50—54)

Female: Body length 250 μm , width 225 μm . Length of legs 560; 420; 515; 610 μm . Five pairs of mc : 180; 155; 70; 70; 35 μm . Nine pairs of l : 80; 35; 60; 25; 60; 40; 40; 35; 35 μm . Inter-setal

distances: l_1-l_2 ; l_2-l_3 ; $l_3-l_4 = 30$; 35; 45/50 μm . Leg setation: coxae 3-1-2-2, trochanters 1-1-1-1, femora 4-3-3-2, genua 1-1-1-1, tibiae 9-8-7-7, tarsi 10-10-7-7.

Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 3 + 1 sword-like seta, tarsus 1 + 1 eupathidium. Bands of coarse striae like those of *T. lombardinii* occur on the dorsum. Mc_2 and mc_3 long, mc_4 , mc_5 of moderate length and mc_6 short.

The most distal seta on femur II is very short. Palptarsus only with one seta and one eupathidium.

Male: Unknown.

Type material: Holotype ♀, Israel, Mount Carmel, in pine litter, 12.xii.1974, U. Gerson (HUJ no 2750).

Remarks: *T. stramenticola* differs from *T. polonicus* spec. nov. in having only one seta on the palptarsus. L_3 is much shorter than l_1 . The mc setae differ from those of *T. polonicus* spec. nov. and *T. lombardinii*.

Tycherobius polonicus spec. nov.

(figs. 55—60)

Neophyllobius superbus; Kuznecov & Livshits, 1979: 82, 101. Misidentification.

Female: Body length 320 μm , width 295 μm . Length of legs: 615; 500; 540; 655 μm .

Five pairs of mc setae: 235; 205; 95; 85; 35 μm . Nine pairs of l : 80; 55; 80; 30; 70; 60; 55; 30; 30 μm . Inter-setal distances: l_1-l_2 ; l_2-l_3 ; $l_3-l_4 = 25$; 40; 60 μm . Leg setation: coxae 3-1-2-2, trochanters 1-1-1-1, femora 4-3-3-2, genua 1-1-1-1, tibiae 9-8-7-7, tarsi 10-10-7-7. Pedipalp setation: trochanter 0, femur 2, genu 1, tibia 3 + 1 sword-like seta, tarsus 2 + 1 eupathidium. Bands of coarse striae like those of *T. lombardinii* present on dorsum. The two anteriolateral setae on femur III are short, more separate and not touching each others bases as is the case in *T. lombardinii* and *T. stramenticola*. L_3 are long, subequal to l_1 . Mc setae with blunt-tipped spines.

Male: Unknown

Type material: Holotype ♀, Poland, locality, host and date unknown, M. Kaliszewski (UAM 10. S/6 R626).

Remarks. *T. polonicus* resembles *T. stramenticola*. It differs from the latter by having two short anterior setae on femur III which are

more widely spaced than those of the latter species. L_3 as long as l_1 while in *T. stramenticola* l_3 is much shorter than l_1 . The palptarsus has two setae instead of one as in *T. stramenticola*.

The specimen identified by Kuznecov & Livshits (1979) as *T. superbus* appears to be *T. polonicus*. Mc setae in *T. polonicus* are different from those of other *Tycherobius* spp.

Tycherobius virginienis (McGregor) comb.

nov.

(figs. 61—66)

Neophyllobius virginienis McGregor, 1950: 69, 70.

Female: Body length 295 (305) μm , width 255 (360) μm . Length legs: 500 (470); 390 (375); 445 (445); 515 (515) μm . Six pairs of mc : 2 (3); 3 (3); 3 (3); 3 (3); 30 (25); 30 (30) μm . Nine pairs of l : 55 (55); 35 (40); 30 (35); 30 (35); 40 (45); 35 (40); 35 (40); 35 (35); 30 (30) μm . Inter-setal distances: l_1-l_2 ; l_2-l_3 ; $l_3-l_4 = 40$; 10; 55 μm . Leg setation: coxae 3-1-2-2, trochanters 1-1-1-1, femora 4-3-3-2, genua 1-1-1-1, tibia 9-8-7-7, tarsi 10-8-7-7. Pedipalp setation: trochanter 0, femora 2, genua 1, tibia 3 + 1 sword-like seta, tarsi 1 + 1 eupathidium.

From the outer margin a band of coarse striae runs medially behind l_8 and anteriorly in a curve behind mc_5 , to rejoin the margin behind l_8 . The rest of the dorsum is covered with a fine tortuous striation. Only a single centrally located mc_1 seta is present and situated immediately behind l_1 . Mc_2 setae situated far away from mc_1 , in line with l_4 . Mc_3 setae more separated from each other than the other mc pairs. Mc_5 located close to each other whereas mc_6 are contiguous. Mc_{1-4} can be vestigial as a consequence of mutilation.

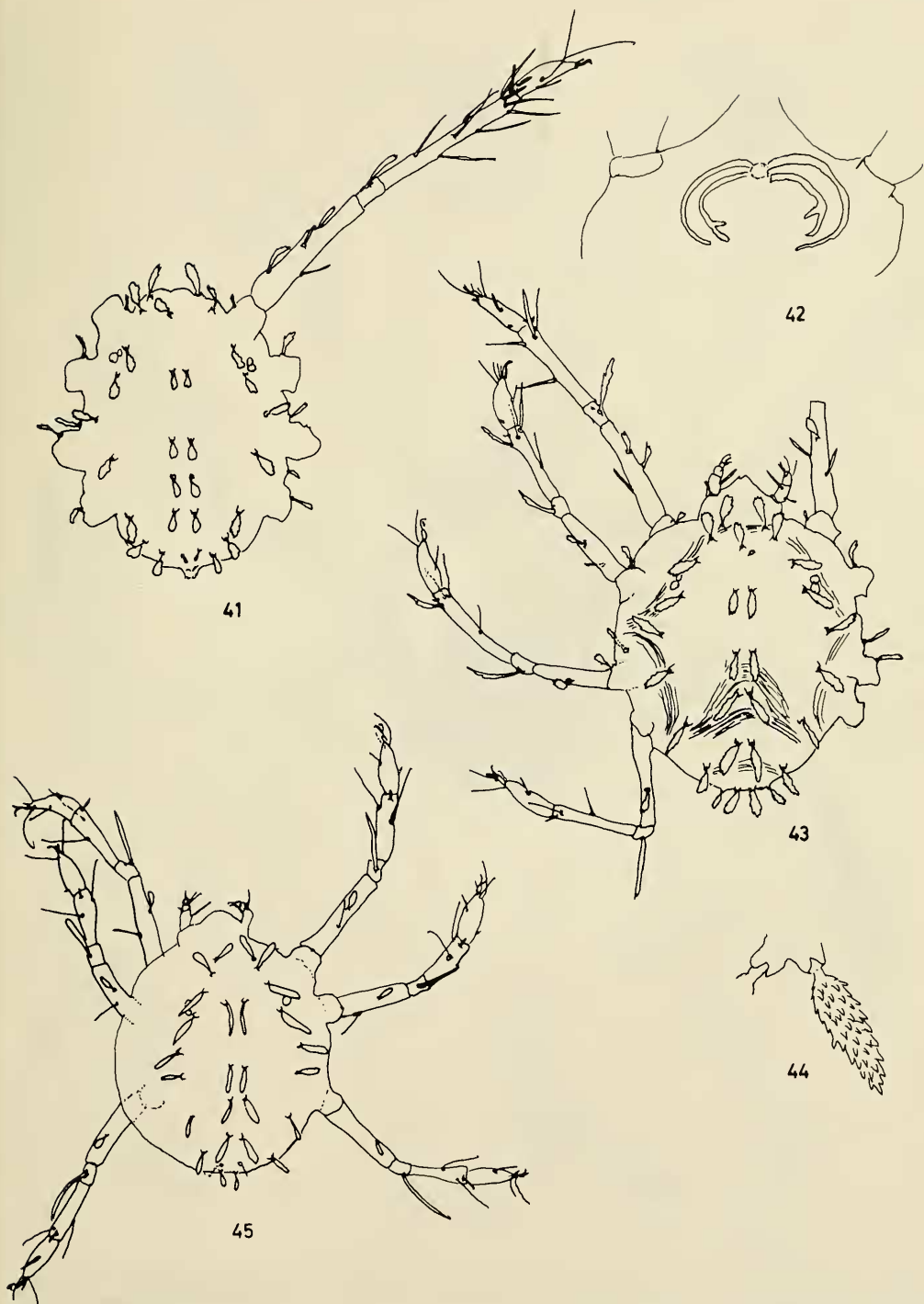
The distance between l_2 and l_3 is very short in comparison with the other *Tycherobius* spp. and they are nearby contiguous.

Male: Unknown.

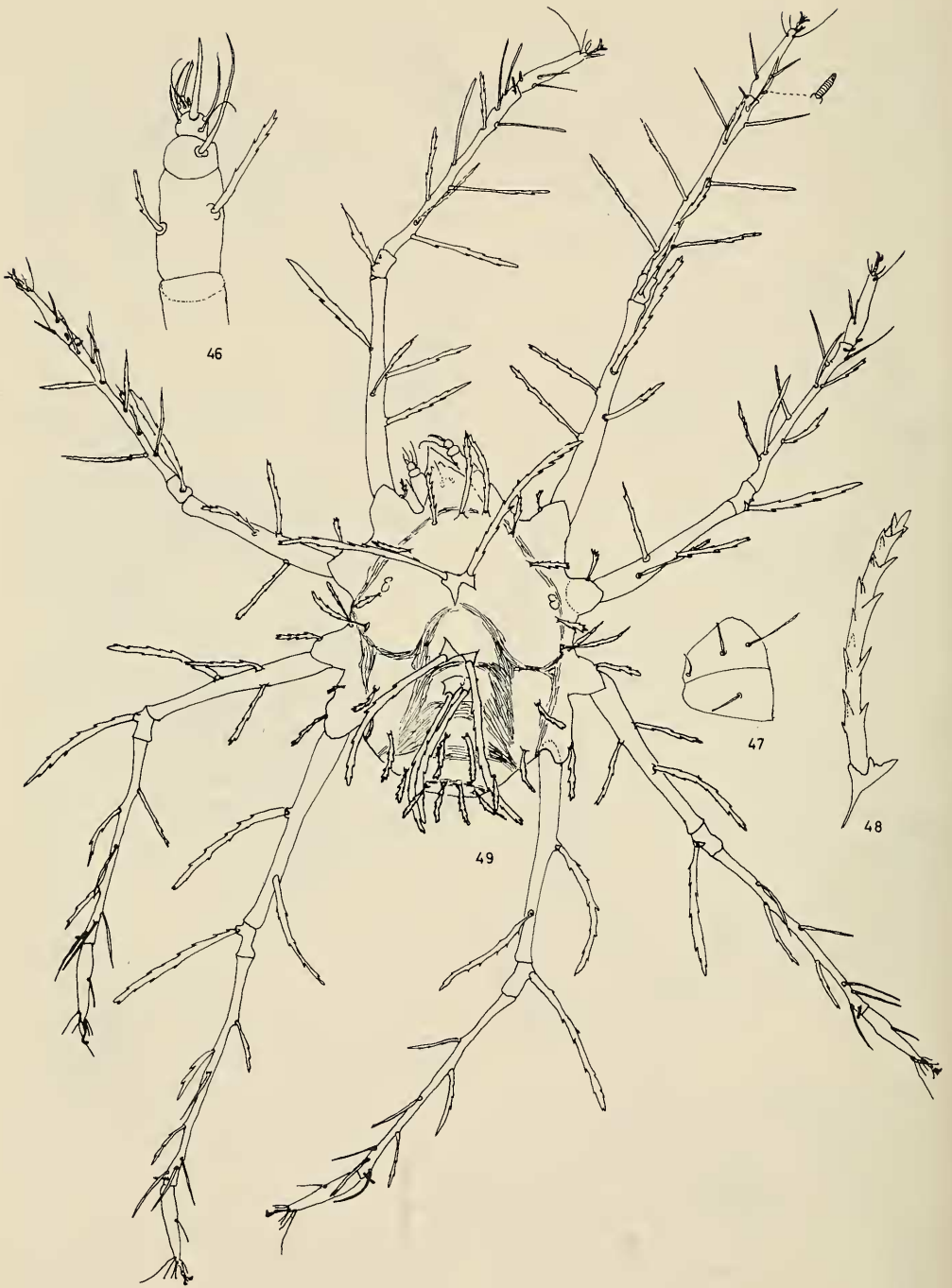
Material examined: "Cotype" ♀, USA, Virginia, Arlington, from sample E-7483, xi.1938, F. Andre (USNM no 1748). 1 ♀, USA, Florida, Lake Placid, in sand-pine litter, 16.xii.1964, M. H. Muma & H. L. Greene (DCDG).

Other published material: "Cotype" ♀, USA, Virginia, Arlington, second slide from sample E-7483, xi.1938, F. Andre (USNM no 1748).

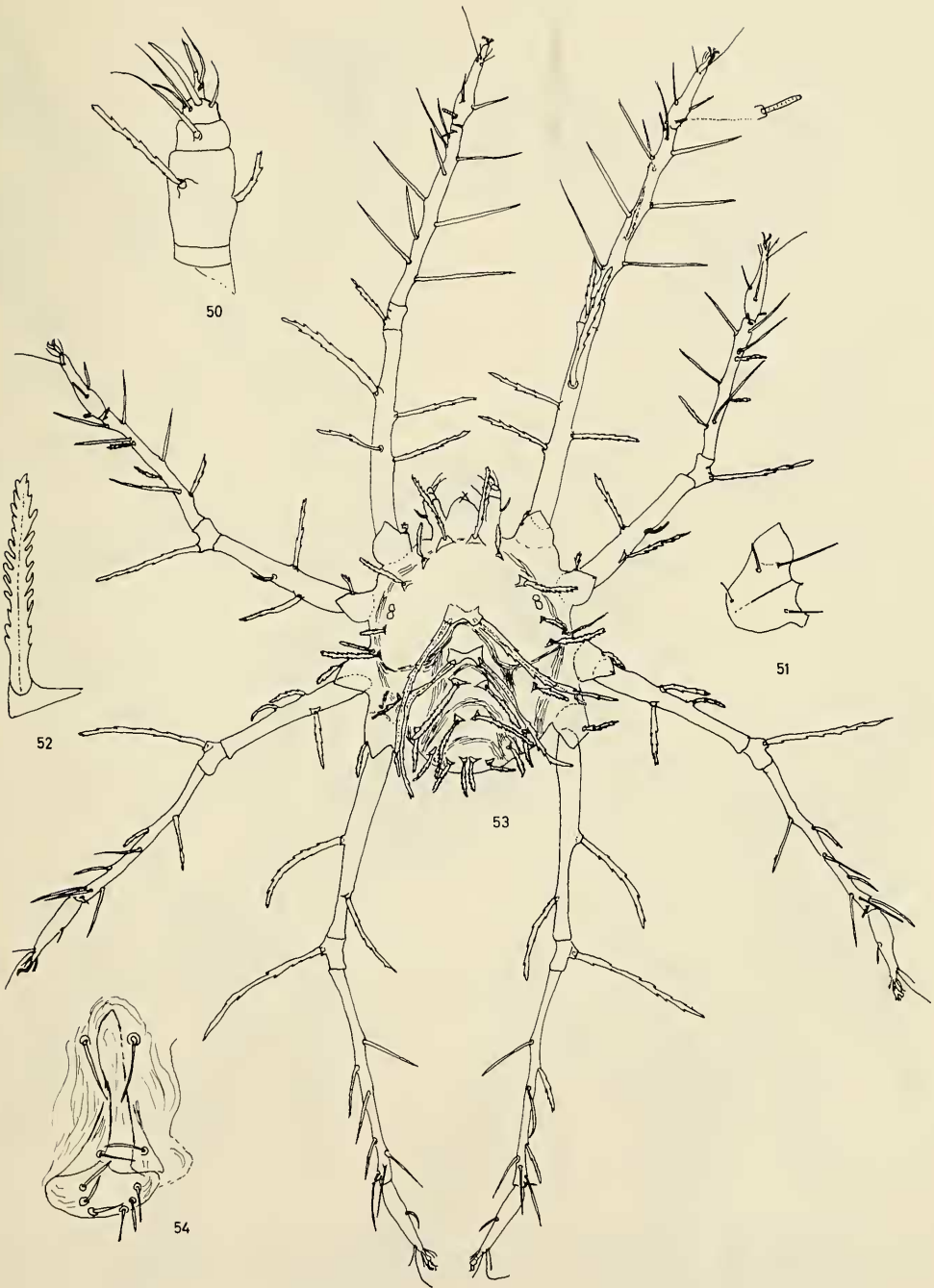
Remarks. The unpaired mc_1 seta, the shorter and different positioned dorsal setae, the place of the only coarse transversal striae bandage and eight setae on tarsus II, separate this species from other *Tycherobius* spp.



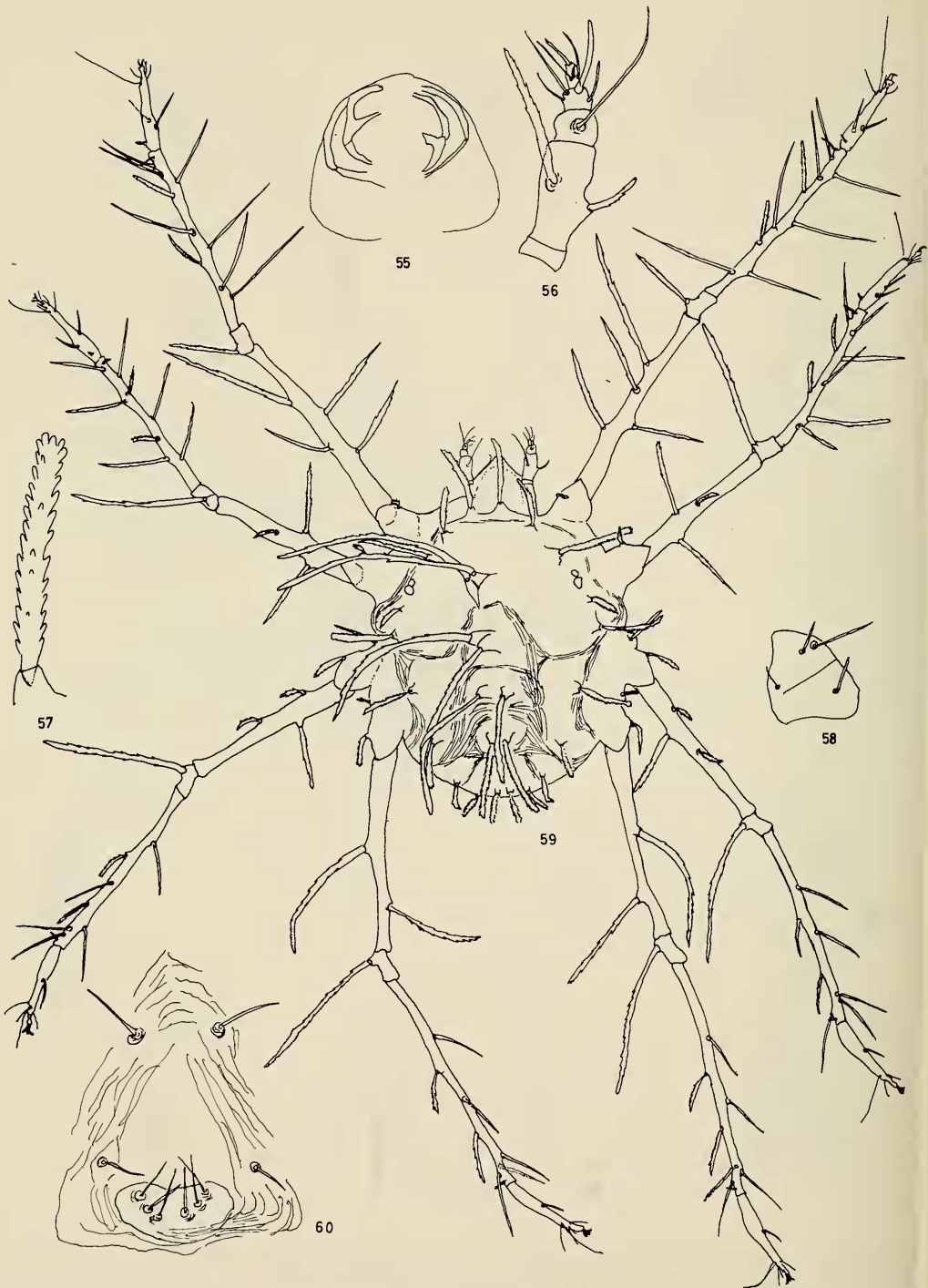
Figs. 41—45. *Tillandsobius floridensis* (McGregor) comb. nov. ♂. 41, dorsal view; 42, peritremata; protonymph. 43, dorsal view; 44, dorsal seta; larva. 45, dorsal view.



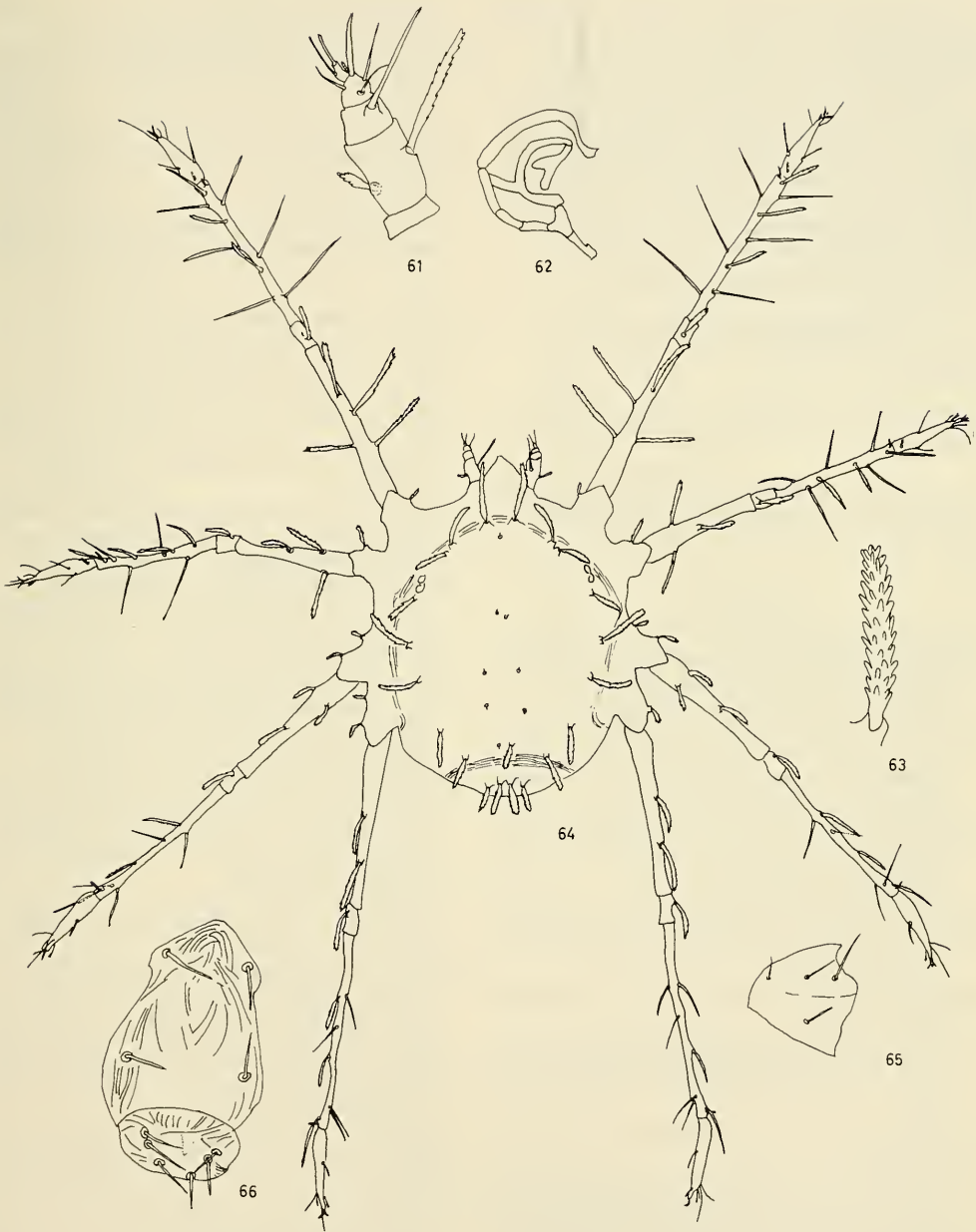
Figs. 46—49. *Tycherobius lombardinii* (Summers & Schlinger) comb. nov., ♀. 46, pedipalp; 47, coxae I and II; 48, *l*₃ seta; 49, dorsal view.



Figs. 50—54. *Tycherobius stramenticola* spec. nov., ♀. 50, pedipalp; 51, coxae I and II; 52, l_5 seta; 53, dorsal view; 54, genital-anal region.



Figs. 55—60. *Tycherobius polonicus* spec. nov. ♀. 55, peritremata; 56, pedipalp; 57, l_5 seta; 58, coxae I and II; 59, dorsal view; 60, genital-anal region.



Figs. 61—66. *Tycherobius virginiensis* (McGregor) comb. nov., ♀. 61, pedipalp; 62, left part of peritremata; 63, l_5 seta; 64, dorsal view; 65, coxae I and II; 66, genital-anal region.

The following species is tentatively assigned to *Tycherobius*. Confirmation requires study of the type series.

Neophyllobius rhytis Chaudhri 1974: 190—191, fig. 83. Type-material: holotype ♀, Pakistan, 3 mi. W. Hyderabad, on unidentified host-plant no. 4/71, 12.xi.1971, W. M. Chaudhri (DEUAL). Paratype ♀, Pakistan, 2 mi. N. Balakot, 3500, *Hedera himalaica*, 13.vi.1971, W. M. Chaudhri (DEUAL).

This species has six pairs of *mc* setae.

Neophyllobius Berlese, 1886

Neophyllobius Berlese, 1886

Type species: *Neophyllobius elegans* Berlese, 1886.

The species of the genus *Neophyllobius* will be described in separate papers in the near future.

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